

NASA SBIR/STTR Technologies

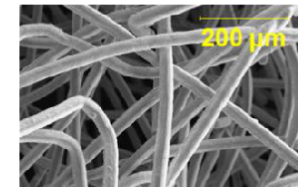
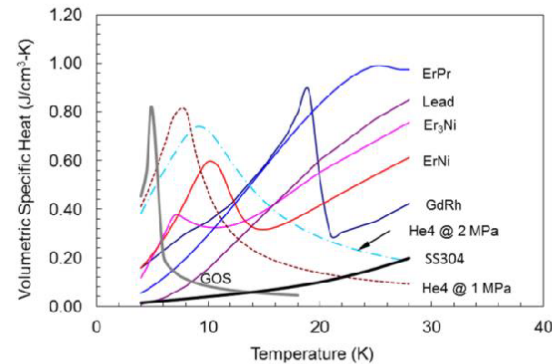
S1.10-8853 - A High Efficiency 30 K Cryocooler with Low-Temperature Heat Sink



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Identification and Significance of Innovation

- Highly efficient, reliable, lightweight cryocooler for science instruments in planetary missions
- Innovative regenerator fabrication process to enhance regenerator thermal efficiency and thus overall cooler performance
- Unique, reliable process to enhance heat capacity of regenerator at low temperature
- Tunable regenerator flow passage geometry for optimal thermal and fluid performance
- Enabling technology for low-temperature (< 40 K) regenerative cryocoolers
- Benefits
- Very efficient, low cooling temperature with Carnot COP >11%
- Low-cost, reliable cryocooler
- Lower power input and lighter cryocooler



Innovative Rare-Earth Regenerator Used to Enhance Cryocooler Performance at Low Temperatures

Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

Phase I Results:

Demonstrated that heat capacity of advanced regenerator is more than 3 times that of standard regenerator below 40 K
Demonstrated by analysis that miniature cooler can provide >0.25 W of cooling at 30 K with only 10 W input power

Technical Objectives:

Low-cost fabrication approach for high performance regenerator
High heat capacity and heat transfer performance for regenerator
Efficient, reliable, and robust 30 K cryocooler with 150 K heat sink

Phase II Work Plan:

Optimize regenerator fabrication processes
Demonstrate reliable and efficient 150 K compressor and displacer
Optimize cryocooler and characterize its performance
Preliminary environmental testing and short-term life testing

NASA Applications

Cryocooling systems for MgB₂ thin-film bolometers for applications in far-infrared instruments, sensors on single planetary smallSat or constellations of smallSats/Cubesats on planetary science missions, high altitude balloons

Non-NASA Applications

Low temperature (< 30 K) cryocooling systems for space-based surveillance
Highly efficient Stirling cryocoolers providing cooling at 20 to 40 K, a temperature range that is currently unachievable with commercial Stirling cryocoolers

Firm Contacts

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NON-PROPRIETARY DATA